Jurnal Ilmiah Multidisiplin Indonesia (JIM-ID)
Volume 1, Number 02, July 2022
doi.org/10.58471/esaprom
E.SSN 2828-9463 (Online)

Comparison Of Feasibility Of Concrete And Asphalt Road With Analityc Hierarchy Process (AHP) Method

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ABSTRACT

This study specifically tries to apply the AHP (analytic hierarchy process) method in the interest of formulation and decision making in the field of engineering, especially for evaluating the comparison of road construction feasibility between asphalt and concrete roads. It is hoped that through this study it can be proven that the AHP method, which is widely used in management decision making, is reliable enough to be applied in engineering and engineering, so that it can assist policy makers in the process of making objective decisions, especially in government circles. This study method includes data collection and analysis methods. For data collection, this study uses a questionnaire method that contains questions related to technical and non-technical factors that are used to assess the feasibility of a road. A total of 16 questions in the questionnaire. Questionnaires were distributed randomly to around 30 respondents who were divided into various groups such as the Department of Highways, consultants, university lecturers, contractors and the general public around the Demak – Godong highway. The results of the questionnaire in the form of answers from respondents were then recapitulated and searched for the dominant answer for each question. The dominant answer is then scored based on the Saaty rating scale. These values are then formed matrices with certain patterns. The AHP method was then applied to analyze these matrices. The results of calculations using the AHP method are in the form of eigenvectors where each value in the vector indicates the value of the proposed alternative (in this case asphalt and concrete construction). From the results found in the analysis, recommendations can then be given as follows: 1) Changes in construction from asphalt to concrete as is currently being carried out on the Demak – Godong highway need to be supported considering that in many ways concrete construction is more feasible than asphalt construction. from this study and 2) the data for the AHP method in this study rely on respondents' assessments of the proposed factors, because the assessments will vary greatly from one another (as indicated in the frequency distribution of the data), the increase in the number of respondents with wider sources involving experts needs to be done in order to maintain data consistency.

Keywords:
water pump, thermal energy, diethyl ether, power, efficiency

INTRODUCTION

The road, in the context of the network, can be interpreted as a segment that connects one node to another node[1]. In the context of the transportation system, roads are infrastructure that functions as a place where traffic of people, goods or vehicles can move from the point of origin

to the point of destination.[2]. The construction and development of road infrastructure, especially in the process of determining road projects, is generally prepared based on the scale of need and urgency as stated in the List of Proposed Project Plans (DURP). However, the reality on the ground shows that there are many discrepancies between the DURP and the approved project plan as stated in the Project List (DIP).[3].

One of the factors suspected of causing the above conditions is the too dominant policy makers (decision makers) in determining the handling of road projects without being based on objective considerations such as elements of urgency and needs.[4]. As a result, many projects that should use a certain system or on a certain priority scale can change to another system or other priority[5].

This study specifically wants to try to apply the AHP method in the interest of formulation and decision making in the technical field, especially in the field of handling road projects in the government environment (read: Bina Marga). The AHP method itself provides a way or pattern that every decision is made based on tested criteria such as cost comparisons, construction durability as well as in terms of qualitative assessments in the form of comparisons of comfort levels, environmental impacts, social impacts, availability of materials & equipment on site, methods & implementation technology[6]. The analytical hierarchy process or abbreviated as AHP is a decision-making approach designed to assist in finding solutions to complex multi-criteria problems in a number of application domains.[7]. This method has been found to be a practical and effective approach that can consider unstructured and complex decisions[8]. The final result of AHP is a ranking or priority weighting of each alternative decision or called element[9]. Basically, there are three steps in decision making with AHP, namely: building a hierarchy, assessment; and priority synthesis.

METHOD

This research procedure follows the line of thought as shown in Figure 3.1 and can be explained as follows:

a. The background of the research is the importance of an objective and accurate assessment of the selection of concrete and asphalt road applications. With this assessment, the reasons and quality of each alternative road construction are known
b. From the background then formulated the aims and objectives of the research. Among the aims and objectives of the study is to determine the feasibility of each type of road construction, especially concrete roads and asphalt roads based on the Analytical Hierarchy Process (AHP) assessment.
c. A search of the literature is needed as an effort to understand the theoretical foundations that support the objectives to be achieved in the research. As a reference and comparison material, reviews of previous studies that have similar themes or have similarities in the subject matter are also given.
d. Data is collected from related agencies.
e. The data obtained is then processed. The data that has been processed is then analyzed using the AHP method which has been selected from various libraries taken as research reference material.
f. The results of the analysis are concluded and recommendations are given.

Primary data were obtained from surveys in the field using the questionnaire method or direct interviews with expert respondents, people with experience with road works, or the general public. The data includes weather resistance, resistance to ground movement, resistance to traffic changes, economic life, maintenance period, surface comfort, flexibility of replacement, ease of implementation, and availability of funding sources. Secondary data includes data on procurement or construction costs, annual maintenance costs, and the amount of traffic.

Table 1. Data on road construction and maintenance costs

No.	Fee Type	Cost (Rp./km)	Description
1.	Early development		

	Concrete	2.5 Billion	Planned life of 25 years
	Asphalt	0.9 Billion	Planned life 5 years
2.	Maintenance		
	Concrete	-	No maintenance
	Asphalt	20 million	Every 1 year

The final result of AHP is a ranking or priority weighting of each alternative decision. This section introduces a conceptual approach for assessing the feasibility of road construction types using the AHP model. In the model proposed in this study, there are at least 5 hierarchical levels as follows:

a. Level I: The goal of the decision to be taken is placed at the top of the hierarchy. In this case the intended target is "choosing the feasibility of road construction for the Demak - Godong road"
b. Level II: At the second level, assessment criteria are proposed from the technical side of road construction that can indicate the quality or level of road service. These criteria consist of weather resistance, soil movement resistance and resistance to traffic changes
c. Level III: At the third level, sub-criteria related to road services are proposed, such as comfort, maintenance period, ease of implementation, and availability of resources.
d. Level IV: At the fourth level, sub-criteria related to procurement or development costs are proposed
e. Level V: At level V, alternative types of road construction that can be applied to the Demak – Godong section are proposed, namely Concrete Construction and Asphalt Construction.

RESULTS AND DISCUSSION

The survey on respondents' perceptions of the feasibility of asphalt roads and concrete roads in terms of several factors was carried out by distributing 30 questionnaires to a number of people from different backgrounds. Respondents were selected based on categories, where each category was considered to represent a particular element of society who was more or less in touch with road problems or felt the use of asphalt or concrete roads. The survey was conducted by surveyors who were equipped with a questionnaire sheet containing 16 questions. A total of 40 questionnaires were distributed. A total of 32 pieces were returned and filled in, while the rest did not return within the allotted time. Of the 32 items that were filled in, 1 of them could not be used because some questions were not filled in or filled with multiple answers,

For question number 1 (weather resistance factor vs. resistance to ground movement), the most answer is point (g) which is resistance to ground movement is more important than resistance to weather. While the lowest answer is point (b) which is resistance to weather is slightly more important than resistance to ground movement.

For question number 2 (weather resistance factor vs. resistance to traffic changes), the most answers are point (e) namely resistance to traffic changes is more important than weather resistance. While the lowest answer is point (a) namely weather resistance is as important as resistance to traffic changes.

For question number 3 (the factor of resistance to ground movement vs. resistance to traffic changes), the most answers are point (b) namely resistance to ground movements is slightly more important than resistance to traffic changes. While the lowest answer is point (c), which is resistance to traffic changes is slightly more important than resistance to ground movement. For question number 4 (road surface comfort factor vs. ease of development implementation), the most common answers are point (a) namely road surface comfort is as important as the ease of development implementation. Meanwhile, the lowest answer is point (b), namely the comfort of the road surface is slightly more important than the ease of implementation of development.

For question number 5 (road surface comfort factor vs. maintenance period), the most answers are point (e) which is the maintenance period is more important than road surface comfort. Meanwhile, the lowest answer is point (f), which means that the comfort of the road surface is more important than the ease of implementation of development. For question number

6 (road surface comfort factor vs. availability of resources), the most common answer is point (e) which is a statement that the availability of resources is more important than the road surface comfort factor. While the lowest answers are points (b), (d), and (h). For question number 7, the factor of ease of implementation of development vs. maintenance period), the most answers are point (e) namely the maintenance period is more important than the ease of implementation of development. While the lowest answers are points (b), (f), and (h).For question number 8 (factor of ease of implementation of development vs. availability of resources), the most common answer is point (g), which means that availability of resources is more important than the ease of implementation of development. While the lowest answers are points (d) and (h). For question number 9 (the factor of treatment duration vs. availability of resources), the most answers are point (e) namely the availability of resources is more important than the length of treatment. While the lowest answer is point (d) which is a statement that the duration of treatment is more important than the availability of resources.

The results of the assessment of respondents' answers to each question can then be formed a matrix. The formation of the matrix is carried out for each group of questions with an order according to the number of questions in each group as described in the previous section.

The procedure for entering answers is as follows:

a. Each respondent's answer to each question will be assessed according to the Saaty . rules
b. The results of the assessment in one question for all respondents (45 people) then averaged
c. The average value is the answer that represents all respondents for each question
d. The value is next entered in a paired matrix and placed according to the pairs between the factors under consideration

Included in the technical factors are 1) weather resistance, 2) resistance to ground movement, and 3) resistance to changes in traffic. The weighting for the three factors was carried out using the eigen method. The final results of the weighting are as follows: 1) Weather resistance, the weight value is 0.49; 2) Resistance to ground movement 0.35; and 3) Resistance to traffic changes of 0.16. Included in the non-technical factors are 1) Road surface comfort, 2) Ease of development implementation, 3) Road maintenance period, and 4) Availability of resources. The final results of the weighting are as follows: 1) Road surface comfort is 0.221; 2) Ease of implementation of development 0.123; 3) Duration of road maintenance is 0.328; and 4) Availability of resources 0.328.

The results of the weighting for Alternatives based on Technical Factors are 1) based on the weather resistance factor, the value for concrete is 0.86 and asphalt is 0.14; 2) based on the power factor to soil movement, the value for concrete is 0.86 and asphalt is 0.14; and 3) based on the factor of resistance to traffic changes, the value of concrete is 0.83 and asphalt is 0.17. The results of the weighting for alternatives based on non-technical factors are 1) based on the road surface comfort factor, the value for concrete is 0.17 and asphalt is 0.83; 2) based on the ease of construction implementation, the value for concrete is 0.17 and asphalt is 0.83; 3) based on the factor of treatment period, the value of concrete is 0.85 and asphalt is 0.15; and 4)) based on the availability of resources, the value of concrete is 0.33 and asphalt is 0.67.

The results of the alternative weighting based on technical factors are 1) Weight for concrete construction is 0.853 and 2) asphalt construction is 0.147. The results of alternative weighting based on non-technical factors are 1) Weight for concrete construction is 0.444 and 2) asphalt construction is 0.556. The results of the weighting for the cost factor are 1) Weight for concrete construction is 0.333 and 2) asphalt construction is 0.667.

Discussion

The results of the weighting of technical factors show that among the three existing technical factors, the factor that is considered the most dominant to measure the feasibility of asphalt roads and concrete roads is the power factor against the weather (0.491). The second factor is resistance to ground movement (0.347) and the last is resistance to traffic changes (0.162). These results indicate that respondents view weather resistance as being very important

to the feasibility of a road, especially because changes in weather generally often trigger damage to a construction (eg due to rain, puddles, etc.) more than other factors.

Table 2. Results of weights for technical factors

No.	Factor	Weight
1.	Weather resistance	0.491
2.	Resistance to ground movement	0.347
3.	Resistance to traffic changes	0.162

Meanwhile, a minor factor is the factor of resistance to changes in traffic. For the most influential non-technical factors to assess the feasibility of a road is occupied by the factor of maintenance period and availability of resources (0.328). The maintenance period relates to the speed with which a construction requires repair. Meanwhile, the availability of resources is mainly related to the availability of funds. These two factors dominantly indicate that 1) as little maintenance and repair as possible means that road construction is considered better, and 2) availability of resources, especially funds, is a factor that will determine whether a construction is chosen to be built or not. Because basically funds are always an obstacle, especially in the midst of the limited road construction budget in Indonesia.

Table 3. Weighting results for non-technical factors

No.	Factor	Weight
1.	Road surface comfort	0.221
2.	Ease of implementation of development	0.123
3.	Road maintenance period	0.328
4.	Availability of resources and technology	0.328

Meanwhile, another important factor to consider is the problem of road construction surface comfort (0.221). This factor is important because it relates to user comfort after construction is completed. In this study, the convenience factor is also superior to the ease of construction factor (0.123). From the table, it can be seen that the overall concrete construction is better than asphalt construction as indicated by the eigenvalue of concrete construction (0.580) which is higher than the eigenvalue for asphalt construction (0.420). In conclusion, concrete construction is more suitable for the construction of the Demak – Godong road.

Table 4. Final eigenvector results for the feasibility assessment of asphalt and concrete roads

No.	Type of road construction	Weight
1.	Concrete	0.580
2.	Asphalt	0.420

CONCLUSION

That based on the AHP analysis, it is known that the technical factor that has the highest weight is the weather resistance factor (0.491). This indicates that the weather resistance factor is considered the most important technical factor to assess the feasibility of a road based on the respondent's assessment. Whereas based on the AHP analysis, it is known that the non-technical factor that has the highest weight is the resource availability factor (0.667). This indicates that the resource availability factor is the most considered non-technical factor in the selection of roadworthiness based on the respondent's assessment. Of the 8 assessment factors, concrete construction excels on 4 factors, namely weather resistance, soil movement resistance, traffic resistance and maintenance period with an average superiority level of 6 times compared to asphalt construction. While asphalt construction excels in the factors of road surface comfort, ease of implementation of development, availability of resources and technology and costs with an average level of advantage of 4 times compared to concrete construction. From a comparative analysis involving all the factors reviewed, it is known that on average concrete roads are

superior to asphalt roads. This is shown from the results of the weighting for concrete construction reaching 0.580, while the weight for asphalt construction is only 0.420.

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